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Forages for Tomorrow

Our vast grasslands are an inestimable resource. Over half of the total U.S. land area—about a billion acres—produces forage, while 700 million other acres are classified as forage-producing farmland. But wherever forages are grown, they are of little value until marketed through livestock, primarily cattle. Transformed into milk and meat, the annual value of forages is about $8 billion.

Forages are inextricably linked with the production of meat. Indeed, grass and hay account for about three-quarters of the nutrients that beef cattle consume over their lifetimes. Thus forages will loom even greater in importance with estimates that meat production must increase by 35 percent by 1985, and 85 percent by 2000. Can these goals for meat be achieved when forage has been the traditional orphan of the American agricultural scene?

There are encouraging signs of progress. For example, scientists have developed—and ranchers are employing—management practices and insect and pest control methods that treble the productivity of many rangelands. The digestibility of some forages is up by 30 percent. And the improved fixation of nitrogen by legumes not only raises yields, but also saves valuable fertilizer.

Despite these significant advances, a larger research task lies ahead. Agricultural science needs to develop technology for controlling such hard-to-kill shrubs as mesquite which render over 300 million acres of Southwest rangeland unproductive. Arid rangelands also need improved water management practices to increase their carrying capacity. Losses in the feeding quality of hay during harvesting and storage average over 20 percent; these losses can be overcome through development of total systems for seeding, growing, harvesting, processing, and storing forages. Another research need is to genetically improve forage plants so they rate higher in yield, palatability, and nutrients, especially protein.

In other research—whose fulfillment may be years away—scientists are striving to increase the photosynthetic efficiency of forage plants and also to enable them to trap more solar energy. If they succeed, the productivity of forage crops would be greatly expanded, perhaps by 20 to 25 percent.

Research is helping us get more out of our great forage resource. Even so, we need a stir of forage-consciousness at home and abroad. The reason for a broad-based research effort is simple—more protein foodstuffs for the people of the world.

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COVER: Seepage of stock ponds has long been a problem in the calcium-rich soils of the Southwest. ARS researchers have found a way to reduce this loss of needed water by chemically sealing the pond bottoms with applications of sodium carbonate (0174X07–32). Article begins on page 3.

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Curbing Stock-Pond Seepage

DEPENDABLE water supplies on arid rangelands or other remote watershed areas increase the value of these grazing lands because water, not grass, usually limits their carrying capacity for livestock or wildlife.

Topography generally dictates the spacing for watering places. In mountainous areas cattle should not travel more than 1 mile and sheep not more than 2 miles; in the plains, these distances can be doubled. The usual recommendation is to provide one watering place per section (640 square acres) to best utilize grazing lands.

One method of providing these water supplies is to dig ponds in small depressions or canyons to collect runoff for ponds. The ponds, usually constructed in medium- to fine-textured soils, are subject to seepage losses. Such ponds often go dry before the grazing season ends.

Much of this seepage loss, especially in the Southwest, is due to the large quantities of calcium in the soil. Calcium causes clay plates—clay is made up of smooth flat particles—to bunch up, forming a porous structure that lets water seep through easily.

A widely used method of seepage control is the application of sodium salts to soil. Sodium disperses the soil aggregates and causes clay particles to swell and plug the water-conducting soil pores.

In the past, the treatment has usually followed "by-guess and by-gosh" empirical methods, with the thought that mechanical compacting of the soil is a necessary part of the pond-sealing procedure.

Not so any longer.

Treated with sodium carbonate by ARS researchers, this pond now provides a more dependable year-around supply of water for livestock grazing in the Coconino National Forest (0174X07–8).

In this simple field test, carbonate present in calcium aggregate soil is revealed by effervescense following the application of small amounts of hydrochloric acid (0174X11–25A).

Soil from a treated pond. Sodium carbonate has caused the aggregate to break down into fine particles (0174X10–2).

Porous soil structure indicates a high content of calcium in this dry pond bed. To disperse the soil aggregate, Dr. Reginato and technician J. Bennett Miller broadcast specific amounts of sodium carbonate; it will later be disked into the soil to a depth of 3 to 5 inches (0174X11–20A).

Researchers at the U.S. Water Conservation Laboratory, Phoenix, Ariz.—soil scientist Robert J. Reginato, chemist Francis S. Nakayama, and technician J. Bennett Miller—devised a program that has:

- Determined the type and amount of sodium salt suitable for reducing seepage.
- Developed application methods requiring a minimum amount of labor and equipment.
- Established criteria for determining whether chosen sites are suitable for seepage reduction treatment.

Sodium carbonate—soda ash—has proved superior to other salts for modifying the soil structure in stock water ponds. In addition to providing sodium for soil dispersion, the salt provides carbonate for tying up calcium as calcium carbonate.

The chemical sealing of the soil is the result of an ion exchange process. The positively charged sodium ions from the soda ash replace the calcium ions previously attached to the soil. Calcium is responsible for the grainy and porous-structured clavey soil, whereas the

A "booster shot" of sodium chloride and sodium carbonate is broadcast from a boat into a previously treated stock pond. Researchers have found that this surface treatment can reduce seepage to 0.15 of an inch per day (0174X08–25A).

sodium causes the clay particles to swell when wet, break apart, and fill the pores in the soil.

The sodium carbonate performs another useful role by providing the carbonate ions which combine with the calcium ions to form calcium carbonate, an insoluble salt.

Dr. Reginato says that experience has shown that treatment with sodium carbonate should be successful if the following criteria are met:

- Depth of the soil overlying sand, gravel, or porous rock should be at least 12 inches.
- Clay content should be 15 percent or greater.
- Cation exchange capacity (CEC) should exceed 15 milliequivalents per 100 grams of soil. The CEC and the clay content figures can be obtained by taking soil samples for analysis to a county extension agent, a commercial laboratory or, in some cases, a university laboratory. In the West, where many of the soils are calcareous and contain montmorillonite clay minerals, the clay content and CEC percentages are quite often nearly the same.

ARS researchers have run several successful field tests with their treatment. One test was in central Arizona on a Springerville very stony clay. The ¼-acre stock-watering pond had never held water continuously from April until the start of the grazing season in June. Seepage loss before treatment was estimated to be between 2 to 5 inches per day. Analysis showed that 2,000 pounds (about $80 worth) of sodium carbonate applied to the top 3 to 4 inches of soil should seal the pond.

The dry pond was first cleared of rocks and weeds, and the sodium carbonate was scattered by hand as evenly as possible on the soil surface. The salt was then mixed with the soil to a depth of about 3 inches with a small tractor and disk. There was no compaction of the soil. About 12 hours of labor were required for the treatment.

Seepage after the treatment was measured to be 0.15 inch per day and stayed at that level until the pond dried out 14 months after treatment because of lack of runoff. Although the soil cracked extensively during the dry period, when runoff refilled the pond the seepage rate reverted to the 0.15-inch-per-day value measured before the pond dried out.

Seepage eventually increased to 0.30 inch per day 33 months after treatment. Soil analysis showed that the sodium content had decreased in the treated zone.

Working from a boat, the researchers broadcast 300 pounds of sodium chloride and 200 pounds of sodium carbonate into the pond. Seepage declined to 0.15 inch 1 month after the "booster shot."

Water quality remained good, both after the initial soil treatment and after the maintenance treatment. Low seepage rates have been maintained in the pond for 5 years after the initial treatment.

Details of the treatment procedure can be obtained from county extension agents or from the U.S. Water Conservation Laboratory, 4331 East Broadway Road, Phoenix, Ariz. 85040. □

More Nutritious Wheat

The controlled environments of greenhouses are used to grow wheat over-winter. Here, geneticist Virgil A. Johnson examines wheat, high in protein and lysine that, when mature, will be harvested and the seed used for further crosses (0174X30–2).

THREE LINES of wheat—Atlas 66, Nap Hal, and CII3449—constitute an important genetic reservoir for improving the nutritional value of future hard red winter wheats. Used in breeding programs, these lines are capable of increasing both content and quality of plant protein at a time when world needs have closed the gap between supply and demand.

Atlas 66 is the genetic source of high protein in advanced breeding lines developed by a team of ARS and Nebraska Agricultural Experiment Station agronomists at Lincoln. In selections from crosses of Atlas 66 and hard winter wheats, protein levels are 12 to 18 percent higher than those in most commercial varieties.

The potential contribution of Nap Hal and CII3449 to genetic advances in wheat protein content and composition is now indicated in studies by Virgil A. Johnson of ARS and Paul J. Mattern, John W. Schmidt, and James E. Stroike of the Nebraska Station. Nap Hal carries genes for both high protein and higher than normal lysine in the protein. CII3449, an unnamed selection, has the highest lysine level of more than 12,000 entries in the World Wheat Collection.

Most important, the research, supported in part by the Agency for International Development, demonstrates that Atlas 66 and Nap Hal have different genes for high protein, and Nap Hal and CII3449 have different genes for high lysine. When different genes for high protein or high lysine are combined in a breeding program, the progeny of crosses may be richer in protein or lysine than either parent.

This fact holds special promise for the western part of the High Plains production area, where protein levels have gradually declined to a point that

some wheat is not satisfactory for flour. The nutritional value of all wheat would be enhanced by improving the amount and composition of protein. The nutritional quality of wheat protein, like that of other cereal grains, is limited by its short supply of the essential amino acid lysine.

Protein content of wheat grain averages about 12 percent, but it, like yield, is strongly influenced by growing conditions. Atlas 66 and its derivatives, however, have since 1969 consistently produced grain with higher protein than other varieties evaluated in International Wheat Performance Nurseries at sites where the general protein level was low or high, and in comparison with lower- and higher-yielding varieties in the nursery.

Existence of different genes for high protein in Atlas 66 and Nap Hal was demonstrated in a 2-year study at Yuma, Ariz., in which protein content of both varieties exceeded 20 percent. This compares with 17 percent for the hard red winter wheat variety Triumph 64 and 16 percent for the spring variety Lerma Rojo. When Atlas 66 and Nap Hal were crossed, protein levels of progeny were beyond the range of the parent varieties in 44 percent of the third generation and 13 percent of the fourth generation. Apparently, different genes in the parent varieties functioned additively to produce protein levels in the progeny that exceeded the parental levels.

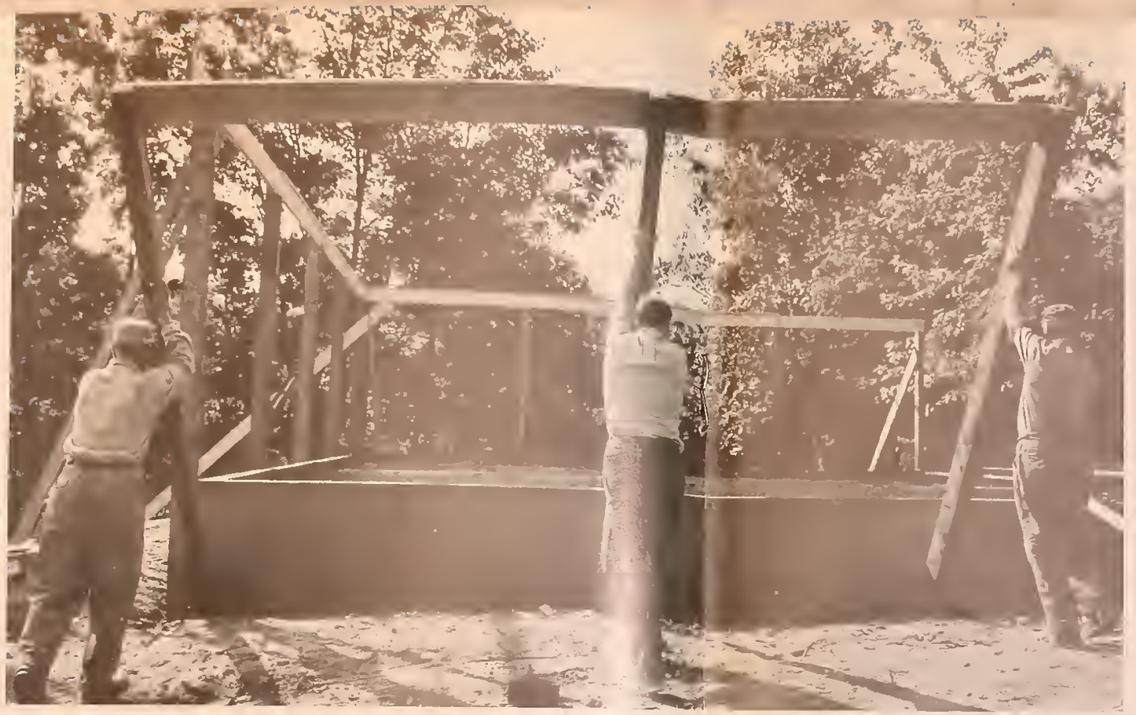
Above: International wheat conference participants examine high-protein wheat varieties in an International Wheat Performance Nursery at Ankara, Turkey. ARS, in cooperation with State and foreign agriculture organizations, has established 55 such nurseries in 35 countries (BN–40980). ***Left:*** *Laboratory technician Betsy Hancock filters solubilized wheat protein in research aimed at determining its amino acid content (0714X33–2A).*

When higher protein Nap Hal was crossed with normal-protein CII3449, the protein range of progeny was above that of CI13449 but lower than that of Nap Hal. A progeny mean of 16.7 percent compared with 15.5 percent for CII3449 indicated partial dominance for low protein.

Another difficulty previously limited attempts to raise levels of protein and lysine simultaneously. An increase in protein was accompanied by a decrease in lysine. The ARS-Nebraska team has now shown that this adverse relationship declines as protein content rises, and that it disappears altogether when protein content is above 16 percent, as it is in many Atlas 66 and Nap Hal derivatives.

Opportunities for improving lysine content were also increased when other studies at Yuma identified separate genes for higher lysine in Nap Hal and CII3449. In the third generation of a Nap Hal-CII3449 cross, 11 percent of the progeny had adjusted lysine levels outside the range of the parents. With separate genes apparently reinforcing one another, scientists have the opportunity to select lines with higher lysine than either parent. The mean adjusted lysine levels of Nap Hal and CII3449 were above 3.2 percent of total protein in the Yuma experiment, compared to only 2.9 percent for Triumph 64 and Lerma Rojo. Several progeny rows produced adjusted lysine levels in the range of 3.6 to 3.9 percent.

CII3449 is of additional interest to plant breeders because it is a semidwarf variety. Semidwarf wheats are less likely to lodge than tall wheats when fertility levels are high. The researchers tested the effect of plant height on protein by crossing semidwarf, normal protein CII3449 and moderately tall, high protein Nap Hal. A small but significant increase in protein appeared to be associated with short plant height under conditions of the test. □



Top: Workers tilt the precut pole frames into position; these provide the basic support for the house. The frames are constructed of 4- by 6-inch vertical, and 2- by 8-inch horizontal sections, with a 2- by 8-inch plate to straighten the frame (0673W1150–28). Upper left: Floor joists that extend the entire length of the house impart rigidity. Here, a construction worker slides the joist sections into place prior to splicing (0673W1149–21). Left: Dr. Newman examines blueprints of low-income house to insure compliance with building instructions (1073B1603–7). Above: Prefabricated foundation panels are fastened by air-powered stapler. Dr. Newman points out that extensive use of staple guns would help the trade save construction time and expense (0673W1151–1).

Cheaper by the Panel

WHAT would you say, in these days of spiraling inflation, to a six-room house that can be put up within a week, costs under $10,000, can be heated at low cost, utilizes largely unskilled labor in construction, and creates employment opportunities for people in the community?

A house, moreover, designed so that the panelized sections that make up the foundation and exterior walls can be dismantled and reassembled elsewhere if necessary? Where inside walls and doors can be shifted to change the size of the rooms? One that's probably stronger than many houses going up today?

Such a house is no fantasy. A simplification of commercial construction techniques makes it a reality, particularly for depressed rural areas where the need is great. An experimental house much like the one described was recently built in Romney, W. Va., under the supervision of Jerry Newman, an ARS agricultural engineer based at Clemson University, Clemson, S.C., and Russell Parker, an architect, at the Agricultural Research Center, Beltsville, Md.

The structure represents, in Dr. Newman's words, "the best overall approach we know of for building an inexpensive good house. Basically, it's a simple one-level building measuring 30 by 32 feet. It contains a living room with a dining area, three bedrooms, kitchen, small entry hall, and utility room."

Several features make this house different from low-cost houses being built today—its use of a pole-frame design combined with non-load-bearing walls, precut and preassembled panels, trusses, and joists.

The pole-frame design provides support for the structure through use of vertical poles extending from foundation to roof, spaced every 8 feet around the perimeter. The design not only provides added structural strength, but also permits flexibility in placing or moving inside walls. These non-load-bearing walls do not support the building. They serve only to divide interior space into rooms, just as they do in a modern high rise or office building.

Use of the precut and preassembled panels, trusses, and joists, which are built by Office of Economic Opportunity (OEO) workers right in the community, make for speedier construction.

"The panelized contruction," says Dr. Newman, "makes it possible for homeowners to do something they've never really been able to do before—to dismantle their homes and reassemble them elsewhere with a minimum of effort and cost. The basic parts of a house don't deteriorate under normal

Preassembled exterior wall section is lifted into position by the construction crew. The sections are fitted inside the 4- by 6-inch vertical frame members, a technique that will eventually allow fabrication of much larger sections. At present, individual length of wall panels is limited by weight alone. Researchers hope someday to fabricate lighter but entire walls in one section (1073B1603–20).

conditions. So, being able to take it apart and put it back together again, or to simply upgrade it or rearrange the rooms, seems to me to be a useful design feature."

The foundation panels were placed directly in an excavation backfilled with 6 to 8 inches of gravel. Footing for the poles consists of pressure-treated wood and, in some instances, solid concrete blocks.

As for speed of construction, Dr. Newman estimates that the main frame for the panelized house can be put up by a crew of four or five untrained laborers, directed by one experienced man, in only a matter of hours.

"You could actually have shelter in a day," says Dr. Newman, "and within a week you would have pretty convenient, comfortable living."

Heating economies are brought about by using peripheral heating—one of Dr. Newman's innovations—used in connection with any standard form of heating, from furnace, fireplace, or stove. This concept utilizes built-in fans in strategic locations to distribute heat uniformly and efficiently throughout the house (AGR. RES., Jan. 1968, p. 4).

The $10,000 figure for the cost of the house can vary, Dr. Newman says, depending on the cost of construction materials in various locations. He believes, though, that the figure is a practical one, probably reflecting the economy of the depressed rural areas for which the house is especially designed, areas where low-cost untrained labor is readily available.

The work at Romney was done under a cooperative agreement between ARS and the Eastern West Virginia Housing Association, an OEO group, which seeks to foster development of local business opportunities. Several low-income families have asked to be considered as buyers of the completed house. The State engineer has approved the design for financing by the Farmers Home Administration. □

Above: William Simms of the Wire Mold Co., Pittsburgh, Pa., installs house wiring in channels after the wall panels are in place. These channels also serve as baseboards and as decorative covers for the hot-air heating system (107B1606–23). ***Right:*** *Construction supervisor Sterling Method (center) and a member of the construction crew discuss the newly completed home with a local resident. Mr. Method also serves as chairman of the Eastern West Virginia Housing Association (0973A1501–9).* ***Below:*** *Movers carry family furniture into the attractively paneled living room, which provides some 960 square feet of living space. A few touchup construction details remain (1073B1605–31).*

These peppers were grown at Beltsville, Md., from Yugoslavian seed. Pepper at right was picked by hand. The other peppers (top and side views) exhibit easy separation of pod from stem, a genetically induced trait that may pave the way toward mechanized harvest of peppers (PN–2850).

Another Candidate for Mechanized Harvest?

A DOMINANT GENE—designated as Ps for pod separation—has been discovered that controls the separation of a ripe pepper from its stem by forming an abscission layer of cells between fruit and stem.

This genetic breakthrough may open the way to broad scale mechanized harvesting of peppers.

The gene was detected by Yugoslav scientists in one breeding line of industrial sweet pepper and in Vandenberg's Lange Rote, a pungent variety of the large fruited cultivated pepper belonging to the species *Capsicum annuum*. ARS is sponsoring this project.

Dr. Allan K. Stoner, ARS-cooperating scientist at Beltsville, Md., reports that both sources of the Ps gene served as the donor parent for crossing with other varieties of *C. annuum*.

Drawing on pod separation data collected on parents and progenies grown both in Yugoslavia and at the Agricultural Research Center, Beltsville, Md., Dr. Vladimir Spasojevic, principal investigator, found that the expression of the dominant Ps gene varies, its efficiency dependent upon the presence and behavior of two or more modifier genes.

The Ps gene controls the excretion of a substance, possibly corklike, between the stem and the placenta of the fruit which makes for easy separation of pod from stem. The complete expression of this gene, however, depends upon the presence of recessive modifier genes that control the form of the stem, the wrinkling of the pod, and the ingrowth of the stem into the pod.

In the varieties crossbred in this program, the Ps gene was manifested and observed on progeny gradually because of the presence of different combinations of modifier genes. Accordingly, successive backcrosses were required, but after the fifth and sixth backcross generations, the Yugoslav scientists established lines with the dominant Ps gene and the recessive modifiers.

The ultimate aim of this 3-year project, begun in 1971, is to develop male sterile Ps stable lines of several different types of peppers—paprika, sweet, pimento, and chillies—as new germ plasm for production of hybrid seed.

This research is being conducted under the provisions of Public Law 480 at the Institute for Vegetables, Karadjordjeva. □

Vanadium-An Essential Element

VANADIUM now joins the ranks of elements know to be essential for health. Nutritional studies from four laboratories demonstrate that vanadium is an essential trace element for rats and chicks. Past studies have shown that these two animal species are among the more reliable models for studying human dietary needs.

Proper nourishment demands that dietary habits provide all the nutrients needed by the body. Accordingly, nutritionists must identify essential elements. As part of this effort, nutritionist Leon L. Hopkins, Jr., Ft. Collins, Colo., and technician Harold E. Mohr, Manhattan, Kans., both of ARS, collected and summarized evidence establishing the role of vanadium in nutrition.

The researchers drew their conclusions from their own studies conducted earlier at Beltsville, Md., as well as those of the ARS Human Nutrition Laboratory, Grand Forks, N. Dak., Purdue University, Lafayette, Ind., and the Veteran's Administration Hospital in Long Beach, Calif.

These studies show that the physiological functions of test animals become impaired when they consume a diet low in vanadium. Functions affected include: reduced feather and body growth; impaired reproduction and survival of the young; altered red blood cell levels and iron metabolism; impairment of hard tissue metabolism; and altered blood lipid levels.

Dr. Hopkins says that the required vanadium level may be between 50 and 500 parts per billion (ppb) when the element is consumed in a purified diet. This requirement may be higher when the vanadium comes from natural feeds and foods.

Analysis of several popular meats, vegetables, fish, and feed grain samples yielded vanadium levels of less than 100 ppb, raising a question about their nutritional adequacy.

According to Dr. Hopkins, vanadium deficiency will probably show up in the form of altered blood lipid levels since it is well established that vanadium alters lipid metabolism. Marginal vanadium deficiencies in humans may be responsible for at least part of the altered blood lipid levels observed in society today. Furthermore, Dr. Hopkins says that if refinement and purification of diets continues without the replenishment of extracted trace elements such as vanadium, tomorrow's nutritional problems may prove even more serious. □

A Better Way to Propagate Elms

DISCOVERY of American elms resistant to widespread Dutch elm disease has led to studies resulting in improved propagation of these cherished trees.

ARS plant pathologist Lawrence R. Schreiber, using several hydroponic solutions, has found ways to enhance root initiation and growth in cuttings of American elm seedlings.

He produced root systems of superior quality in hydroponic solutions containing monobasic potassium phosphate in 0.002 molar concentration with either 10 or 25 parts per million (ppm) of the growth hormone, indole-3-acetic acid (IAA). Another solution, one that the studies proved to be almost equally effective, was potassium nitrate in 0.002 molar concentration with 25 ppm IAA.

Dr. Schreiber noted, however, that no single nutrient formulation produces optimum root growth for all species or selections within a species. When attempting to root cuttings, he said, one must consider such influences as season, climate, plant age, and plant parts to be propagated.

In his experiments, conducted at Delaware, Ohio, Dr. Schreiber found the plant parts taken from the base of the stem rooted better than did terminal parts. Cuttings from younger seedlings rooted more readily than those from older plants.

Cuttings grown in tap water and periodically exposed to mists produced more numerous roots that were slightly longer than roots of unmisted cuttings. Misted cuttings grown in Hoagland's solution, a well-balanced nutrient formulation, also produced more roots than their unmisted counterparts. The roots were shorter, and root dry weight consequently was not affected.

Dr. Schreiber said cuttings that were grown in distilled water and misted became chlorotic, possibly because of leaching of essential elements.

Foliage of cuttings grown in solutions that were not aerated also lost some of their green color.

Aeration, however, did not significantly affect average root length in either Hoagland's solution or water. Aeration did increase the number of roots in Hoagland's solution. □

The Right Amount of Nitrogen

Researcher cuts petiole for analysis. This technique provides a midseason verification of the crop's nitrogen status and helps determine the accuracy of nitrogen fertilizer recommendations in relation to amount of irrigation water. It is also useful in making fertilizer and irrigation adjustments during the current season and in future years for maximum production of refined sugar (BN–40894).

New testing procedures promise greater and more profitable production of sugarbeets by indicating the amount of nitrogen fertilizer that will give the best sugar yield.

Sugarbeets obtain nitrogen from two sources in the soil, but most nitrogen soil tests measure only one source. The new procedures evaluate both sources, presenting a more accurate picture of how much fertilizer is needed to supplement the soil nitrogen and produce healthy plants.

To obtain high yields, today's producers often apply more nitrogen fertilizer than necessary. This action appears to be causing a gradual decline in beet quality. Insufficient nitrogen limits sugarbeet root yields. Conversely, excess nitrogen may maximize root yield—but cuts sugar production. Excess nitrogen also interferes with sugar refining processes, cutting sugar production still further.

To reverse this decline, growers needed an accurate method of determining the nitrogen level most favorable for obtaining highest root and refined sugar production. Soil scientist John N. Carter, agricultural engineer Marvin E. Jensen, and technician Shirley M. Bosma, Kimberly, Idaho, developed such a method.

The three ARS researchers first grew sugarbeets at 14 rates of residual and fertilizer nitrogen to determine root yield, sugar percentage, sugar yield, and nitrogen uptake in relation to the residual, fertilizer, and mineralizable nitrogen in the soil.

Mineralizable nitrogen is organic nitrogen, such as from plant material, that bacteria in soil convert to mineral or inorganic form.

Then, to measure the mineralizable nitrogen, soil samples were taken and incubated for 21 days at controlled levels of temperature and moisture.

The researchers next extracted the nitrate-nitrogen from the incubated soil and compared it to nitrate-nitrogen levels contained in the nonincubated soil samples. The difference between incubated and nonincubated soil nitrate-nitrogen concentrations is considered the mineralizable nitrogen.

Knowing the mineralizable and the nitrate-nitrogen levels in the soil helps determine the ideal amount of nitrogen fertilizer to apply. The fertilizer may be applied before planting or as a side dressing early in the season before the period of maximum nitrogen uptake by the beets.

Since the amount of nitrogen supplied from a mineralizable source in a uniformly cropped and fertilized field is expected to remain reasonably constant if a proper amount of nitrogen fertilizer is supplied, yearly tests for mineralizable nitrogen may not be necessary.

Given the level of mineralizable nitrogen in a soil, one need only determine the nitrate-nitrogen level in the soil—readily accomplished with today's methods of soil analysis—to recommend the proper fertilizer treatment.

The use of tissue tests in conjunction with the soil tests will provide a midseason verification of a sugarbeet crop's nitrogen status and will, in turn, project for the grower the sugarbeet crop's root yield and sugar content. Knowing in advance the expected root yield and sugar content enables growers and manufacturers to efficiently prepare for processing a certain volume and quality. Such efficiency maximizes profits to both groups. □

Yellow-eyed genetic marker

A YELLOW-EYED MUTANT of the melon fly, *Dacus curcubitae* Coquillet, that could become a valuable genetic marker for laboratory and field studies, has been discovered by ARS researchers in Honolulu.

A yellow-eyed male was found in the laboratory culture and allowed to mate with normal virgin females from the laboratory's stock in an attempt to perpetuate the desirable yellow-eyed characteristic. After crossing, paired matings of yellow-eyed adults produced progeny that were all yellow eyed.

The yellow-eyed characteristic could serve in sterile release programs so that the flies would be immediately identifiable when caught in traps after release.

Tests were conducted by ARS entomologists Richard M. Kobayashi, Derrell L. Chambers, and Esther L. Schneider to determine whether the yellow color would remain in the eyes of dead flies after exposure to the elements. Flies were killed and placed in plastic traps and exposed to the Hawaiian weather for 2 weeks. In every case, the flies retained the yellow eye color and were distinguishable from normal laboratory flies treated in the same manner.

Further studies will be needed pertaining to lifespan, reproductivity, and mating compatibility to see if the mutant can replace normal laboratory flies. Innate weaknesses associated with mutation have been known to occur among insects.

Toward global salmonella test

A STANDARD TEST for *Salmonella* that can be used by laboratories throughout the world. That is the goal of the International Commission on Microbiological Specifications for Foods (ICMSF). Headquartered in Canada, the Commission consists of representatives of government, university, and industrial laboratories in Argentina, Austria, Canada, Denmark, England, France, Italy, Japan, The Netherlands, the Soviet Union, Sweden, and the United States.

Commission research underway in the United States is funded by ARS. Through an interlaboratory testing program participated in by researchers from member countries, the Commission has made some significant findings about testing for *Salmonella* that should be of value in developing an international standard. Studies on *Salmonella*-contaminated dried foods—such as oilseed meals, fish meals, egg, and chocolate—showed that the amount of testing required can be greatly reduced without loss in sensitivity through use of large, representative samples. It is not necessary to test 60 25-gram samples; these can be combined into 3 500-gram samples with just as reliable analytical results. By thus drastically reducing the number of tests required, a realistic program of *Salmonella* surveillance on an international scale becomes practical.

ICMSF studies on frozen meat have shown a higher rate of *Salmonella* detection if contaminated samples are inoculated in an enrichment culture medium at 43°C. (109° F.) than at 35° C. (95° F.). Still other work with such high-moisture foods as meat, poultry, and eggs has shown that preenrichment in a lactose culture medium to stimulate the growth of all micro-organisms present increases the possibilities for *Salmonella* detection. This procedure takes longer, but it allows cells injured in previous processing to recover, so that when the sample is inoculated in the selective medium for *Salmonellae*, they will all be detected.

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A cold hardiness indicator

SORBITOL—a crystalline and faintly sweet alcohol—may be a good indicator of cold hardiness in apple trees. It is possible that the amount of sorbitol in critical cell areas helps increase a tree's cold hardiness.

Surprise frosts and harsh winters can and do kill plants that lack the cold hardiness to survive. Sugars and alcohols are reported to offer some protection against freezing in leaf cells, but in attempts to correlate sugars and alcohols with cold hardiness, little or no mention has been made of sorbitol, a major component of dormant apple tree tissue.

ARS plant physiologists Max W. Williams and John T. Raese, Wenatchee, Wash., determined the influence of dormant-season temperatures on sorbitol levels in apple trees to shed light on the role played by sorbitol in protecting the trees from the cold.

The researchers collected 2-year-old shoots of Red and Golden Delicious apple trees throughout the cold-months dormant season. They measured sorbitol levels in the sap using vacuum extractions, and the sorbitol in ground dried wood.

In most samples, sorbitol in the sap generally increased with subfreezing temperatures and decreased during warm periods. Apparently, during cold periods, cell wall permeability increases and sorbitol moves into the spaces between the cells. This would account for the high sorbitol levels in the sap. Sorbitol levels in wood changed in the same manner, but only slightly.

Sorbitol appears to be an important component of the carbohydrate reserve in dormant apple trees. Carbohydrate reserves have been linked to cold hardiness. If sorbitol is directly related to cold hardiness, researchers can measure sorbitol levels in sap to predict a tree's ability to withstand cold on its own, without protection. More research is needed to explore sorbitol's potential.

Timely cotton harvesting pays

DELAYING HARVEST beyond the optimum date can be costly for cotton producers in yield, fiber quality, and seed quality.

These were the findings of a 3-year cooperative study by Dr. Lavon L. Ray of the Texas Agricultural Experiment Station and ARS plant pathologist Earl B. Minton working at the Texas A. & M. University Research and Extension Center, Lubbock, Tex.

During the 3 seasons, 12 weekly harvests by hand snapping were made of 3 varieties: Blightmaster A5, Tamcot 788, and Lockett 4789A. All three varieties have stormproof bolls and ground loss was nil. Such field weathering reduced lint yield in all 3 years, with the highest losses occurring at the beginning of the harvest season. Losses ranked from a high 3 percent during the first week down to 0.5 percent the 12th week.

Other findings of the study showed: reduced fiber length by approximately one thirty-second of an inch for each 6 weeks of exposure; reduced fiber strength by slightly more than 2,000 pounds per square inch; reduced weight of lint per seed; reduced seed germination; and lowered grade due to darkened lint.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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